

# PATENT SPECIFICATION

1,187,976

DRAWINGS ATTACHED.

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## COMPLETE SPECIFICATION.

### Improvements in the Manufacture of Recesses of Rectangular Cross-Section Using an Abrasive Jet.

- We, PLESSEY BTR LIMITED (formerly British Telecommunications Research Limited), of Taplow Court, Taplow, Buckinghamshire, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- 10 The present invention relates to the production of recesses of substantially rectangular cross-section. It has particular application to the manufacture of fluidic elements such as are finding increasing application for various control purposes and for the construction of fluid logic circuits. One of the advantages of such devices is their small size, but this presents difficulties in manufacture of the devices, which generally involve a series of ports and cavities, if they are to be accurately of the configuration required. It is often convenient to manufacture these devices by a moulding technique from plastics material but this requires a mould of harder material which may require somewhat complicated machining operations of great accuracy. The chief object of the invention is to simplify the construction of fluidic elements either in a form ready for use or to serve as moulds from which elements of a different material can subsequently be produced in quantity.
- 15 It is already known to make use of an abrasive jet of air for making what are known as pure fluid elements i.e. cavities of special shape, and this offers considerable advantages but may not always be directly suitable since it produces an inclined edge with a somewhat rounded corner on the side to which the abrasive is applied.
- 20 According to the invention, a method of cutting a recess of substantially rectangular cross-section in a block of material having a top layer and a backing layer formed from a material which is more resistant to abrasion than the material of the top layer, comprises the steps of covering the surface of the block opposite to the backing layer with a mask of elastomeric material having an aperture shaped in accordance with the required plan of the recess and cutting through the top layer to the backing layer around the periphery of the required recess using an abrasive jet.
- 25 The mask may be applied by a printing process.
- 30 The invention will be more readily understood by reference to the accompanying drawing, in which:
- 35 Fig. 1 is a fragmentary sectional view of a cut made by an abrasive jet using a known method;
- 40 Fig. 2 is an isometric view showing a pure fluid device being made using an abrasive jet in conjunction with a mask of elastomeric material;
- 45 Fig. 3 is a similar view to Fig. 1 showing a cut made by the technique illustrated in Fig. 2; and
- 50 Fig. 4 is a sectional view taken on the line IV—IV in Fig. 2.
- 55 Fig. 1 shows on a greatly enlarged scale the effect of the normal abrasive jet technique which produces a hole with sloping sides and rounded corners as indicated at 1.
- 60 Fig. 2 shows a pure fluid device being made by the use of a mask 3 of elastomeric material which covers the whole surface of the block 2 except the shape which it is desired to erode.
- 65 The tool is mounted on an engraving, contour-milling or similar machine which allows the jet 4 to impinge on the desired area only.
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It will be realised that, in use, the top of the device will be closed by a cover plate having suitably disposed holes to provide input and output ports.

5 Fig. 3 is a section of an opening produced by the abrasive jet technique in which the corners are sharp, owing to the use of the elastomeric mask 3, in contrast to the rounded corners shown in Fig. 1.

10 Referring to Fig. 4, the block 2 is formed in two layers. The top layer 8, the thickness of which is equal to the desired depth of the recess, is of a material which is suitable for erosion by the abrasive jet. The lower layer 9 is made of a material which is resistant to the abrasive jet and to etching fluid.

The abrasive jet is used to produce only the channel 5 defining the edges of the openings it is desired to produce. This channel, which extends completely through the top layer 8, is then filled with a resist and the main body of material 6 and 7 removed to the same depth by etching process. The whole of the surface except that covering 6 and 7 is already covered with the elastomeric material which serves as a resist so that only the portions 6 and 7 are removed by the etching fluid.

In view of the difference of susceptibility of the two layers 8 and 9 to erosion by the abrasive jet and to etching, the channels 5 and the material 6 and 7 are readily cut through the top layer 8 without significantly cutting into the lower layer 9. If the shape cut out is more complicated than shown in Fig. 2, the lower layer 9, forms a backing support for any "islands" in the fluidic element which would remain unsupported if the block 2 were cut right through.

40 The invention, therefore, represents a significant advance in methods of manufacturing fluidic elements and offers advantages as regards cheapness and accuracy in production.

#### WHAT WE CLAIM IS:—

1. A method of cutting a recess of substantially rectangular cross-section in a block of material having a top layer and a backing layer formed from a material which is more resistant to abrasion than the material of the top layer, comprising the steps of covering the surface of the block opposite to the backing layer with a mask of elastomeric material having an aperture shaped in accordance with the required plan of the recess and cutting through the top layer to the backing layer around the periphery of the required recess using an abrasive jet.

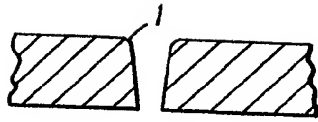
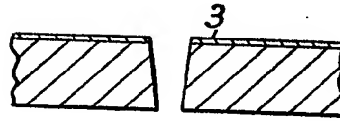
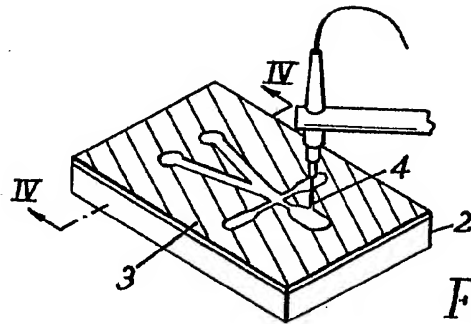
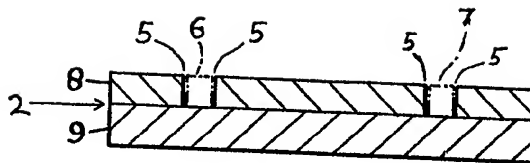
2. A method as claimed in claim 1, in which the remainder of the material in the required recess is removed by an erosion process which is more rapid than the use of an abrasive jet.

3. A method as claimed in claim 1, in which the channel produced by the abrasive jet is then filled with a resist and the remainder of the material in the required recess is removed by etching, the surface of the block surrounding the required recess being coated with a resist.

4. A method as claimed in claim 3, in which the elastomeric material serves as the resist on the surface of the block surrounding the recess.

5. A method of cutting a recess of substantially rectangular cross-section as claimed in claim 1, substantially as hereinbefore described with reference to the accompanying drawing.

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*Fig. 1.**Fig. 3.**Fig. 2.**Fig. 4.*